Evaluation of a crustal deformation model in terms of maintaining the Japanese geodetic datum

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Geospatial Information Authority of Japan introduced semi-dynamic correction in the field of survey in 2010 (Hiyama et al., 2010) to reduce the effect of the strain due to steady-state crustal deformations such as caused by plate motion and to maintain the Japanese geodetic datum. In semi-dynamic correction, the effect of the strain that has accumulated from the reference epoch to the current epoch is corrected by using the crustal deformation model constructed with the use of the data of about 1,300 GNSS Continuously Operating Reference Stations (CORSs). Its deformation values are obtained by interpolation of the differences of the coordinates between the 1st of January in every year and the reference epoch at CORSs. In order to accurately correct the effect of the strain accumulating over time, it is updated every year. Recently, a crustal deformation model that can correct the effect of the accumulating crustal deformation accurately is needed in order to use the coordinates obtained by highly accurate satellite positioning with geospatial information based on the geodetic datum such as to match them to maps. The model for semi-dynamic correction, however, cannot accurately reproduce the crustal deformation including the post-seismic deformation observed after the 2011 Tohoku-oki earthquake.

This study aims to develop a crustal deformation model that can reproduce crustal deformation including post-seismic deformation more accurately in order to maintain the Japan geodetic datum. Although Tobita (2016) and others used models with logarithmic and exponential functions to represent post-seismic deformation, data for a sufficient period are needed to estimate reasonable time constants and coefficients for the functions. On the other hand, a model with simple velocity, which is derived from the difference of coordinates between two epochs divided by the time, can be readily constructed compared to the above model. In this study, we create some crustal deformation models with logarithmic and exponential functions and with simple velocity and evaluate to what degree these models can reproduce the actual crustal deformation observed after the 2011 Tohoku-oki earthquake. In this presentation, we will report the results of the evaluation and discuss the effectivity and limitations of the models.